

Remarks

I. Claim Objections

Applicants noted that misnumbered claims 9-12 have been renumbered as claims 18-21, respectively. Applicants have followed this numbering convention in the “Amendment to the Claims” attached above. Specifically the withdrawn claims 9-17 have been presented.

II. 35 USC 112

The Office Action rejects claims 4, 7, 18 and 19 under 35 USC 112 as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention..

Regarding claim 4; the office action points out that the recitation of “the nanotube” lacks antecedent basis. Applicants have amended claim 4 such that “the nanotube” is changed to “the nanotubes”, which has antecedent basis in claim 1.

Regarding claim 7, the office action points out that the recitation of “applying an electric current the grid” is vague and indefinite. Applicants have amended claim 7 to indicate “applying a voltage between metal lines”.

Regarding claim 18, the office action points out that “the grid of metal line” lacks antecedent basis and does not make sense. Applicants have amended claim 18 such that “the grid of metal line” is changed to “the grid having metal lines”, which has antecedent basis in claim 1.

Regarding claim 19, the office action points out that “neighboring metal lines of the grid” is vague and indefinite as to what is meant by “neighboring metal lines”. Applicants have amended claim 19 such that “neighboring metal lines of the grid” is changed to “two adjacent metal lines of the grid”.

III. 35 USC 102

Claims 1-4, 8-10 (8, 18, 19 according to the new numbering of claims) are rejected as being anticipated by French et al. (U.S. Patent No. 6,946,410B2). Applicants recite summary of the patent by French et al. (col. 2, line 58 to colm 4, line 34) as follows: the invention provides a method for cutting a population of nano-structures to a uniform length or distribution of lengths comprising:

- a) coating a population of nano-structures on a solid substrate wherein the nano-structures are spatially fixed on the surface of the substrate;
- b) identifying discrete portions of the coated nano-structures of step (a) according to a patterning system; and
- c) applying a cutting means to the identified discrete portions of the nano-structures of step (b) whereby the nano-structures are cut to a uniform length or distribution of lengths.

In the following descriptions of preferred embodiments, French et al. added that the naon-structures are canbon nanotubes, and that the nano-structures can be aligned prior to coating the substrate. Additionally, the method may further comprise of dispensing a positive resist and patterning process using photomask and photolithography techniques to expose certain regions of dispersant layer. The photoresist mask may be provided by negative photoresist or imprintable resist. The nano-structures are cut by irradiating the device whereby the exposed dispersant layer which contains nano-rods is degraded.

Applicants respectfully disagree with the Office Action assertion that claims 1-4 and 8-10 are being anticipated by French et al as described above. In claim 1, applicants disclosed a method of creating nanotubes with magnetic atoms that are attached to the wall. This is a very important difference, since the magnetic properties provided by the magnetic atoms allow precise alignment by magnetic field of less than 2 Tesla as in amended claim 5. In absence of magnetic properties of nanotubes, a large magnetic field is generally required to align them, as pointed out by Smalley et al. (US 6,790,425 B1) col. 18, line 39-42. In one embodiment, magnetic field of 25 Tesla is needed. Such high magnetic field would render such alignment method impractical. Secondly, using a grid having metal lines as cutting template is significantly different from using patterned photoresist mask defined using photolithography methods as claimed by French et al. Photoresist patterning requires additional process steps and expensive photolithography tooling to dispense, expose, and develop the photoresist. The unexposed photoresist that covers the dispersant containing nano-structures is known to be nonconductive polymer (positive, negative, or imprint resist materials). Therefore, it is not compatible with the method in claim 7 that a voltage is applied between metal lines as a means to cut nanotubes. In addition, the photoresist mask is not reusable; whereas, the grid having metal lines is reusable to cut nanotubes dispersed on top of it. For example, in order to cut more nanotubes, one would need to remove the photoresist and nanotubes, and then disperse a new nanotube containing dispersant on a substrate, and repeat the photolithography steps described by French et al. In the methods claimed by applicants, one would simply remove nanotubes from the grid and reapply new nanotubes onto the grid. The method in this application offers a much more inexpensive approach for volume production. Therefore, the amended claims 1-4, 8, 18, 19 are non-obvious to those of ordinary skill in the art.

IV. 35 USC 103

Claims 5,7,11 and 12 (20, 21 according to the new numbering of claims) are rejected over French et al. in view of Smalley et al US-6,790,425 B1. Applicants have amended claim 5 to restrict a magnetic field of less than 2 Tesla. As explained in III, this application discloses a method to align nanotubes without having to apply a large magnetic field or field gradient because of much stronger interaction between the magnetic field and the magnetic atoms attached to the wall of nanotubes. A field gradient as mentioned in claim 21, however, is not disclosed by Smalley et al.

Claim 6 is rejected as being unpatentable over French et al. in view of Smalley et al. '783 B1. Applicants respectfully disagree with the Office Action assertion that the same alignment technique of Smalley et al can be applied in '410 B2 of French et al. In '783 B1, the sharp tips are used to "comb" a section of bucky paper as illustrated by Fig. 4, which is an array of free standing carbon fibers with one end attached to the substrate. Since bucky paper is very dense, the tip usually interacts with multiple carbon fibers at a time. In French et al. nano-structures are dispensed onto a substrate, as seen in Fig. 4A. In this invention, nanotubes are dispensed onto a grid having metal lines, as shown in Fig. 4. In both cases, nanotubes are lying in the plane of the substrate surface, and they are relatively dispersed. The interaction force between nanotubes and the scanning row of

sharp tips is a strong function of whether nanotubes are vertically or horizontally placed on the substrate, and also whether nanotubes are densely or sparsely packed. Such "combing" action may be effective in aligning free-standing carbon fibers, but may not be effective in aligning nanotubes dispersed on a substrate, due to additional interaction force from between substrate and nanotubes. Applicants also would like to point out that the object to be aligned by the tips in this invention are nanotubes with magnetic atoms attached to the wall, in contrast to pure nanotubes or other nano-rods in '783 B1 and '410 B2. In addition, the method disclosed by French et al. requires that the alignment of nanotubes occurs prior to application of photoresist patterns, which are used as patterning molds. In this invention by applicants, the alignment as in claim 6 occurs after dispersing nanotubes onto the grid having metal lines, which are the patterning molds.

V. Conclusion

Applicants have responded to the Office Action by amending some of the claims and by showing that the Office Action has not presented a prima facie case of obviousness for any of the claims. As such, applicants respectfully assert that the application is in condition for allowance, and a notice of allowance is solicited.

Respectfully submitted,

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on June 9, 2005.

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